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INTERNALLY THREADED FASTENER AND STEMMED WASHER ASSEMBLY

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January 16, 2002	Carla Deblaw
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INTERNALLY THREADED FASTENER AND STEMMED WASHER ASSEMBLY

BACKGROUND OF THE INVENTION

The present invention relates generally to the field of threaded fasteners, and more particularly to an internally threaded fastener, such as a threaded nut, joined in an assembly with a stemmed washer. The invention also relates to a manner for enabling the effective length of the stemmed washer to vary. The invention also relates to a manner for retaining an internally threaded fastener and such an assembly, and to a method for making the assembly.

A variety of applications are known for threaded fasteners used with standoffs. In a number of applications wherein one or more compressible materials are to be secured, for example, a standoff is commonly inserted into an aperture in the compressible material, and threaded or other fasteners are placed through the standoff for securing the compressible material in a desired position. Compressible materials on which standoffs are commonly used include various plastics, rubbers, foam materials, and so forth, but may also include expanded metals, cellulosic products, and so forth. Moreover, standoffs are also commonly used in applications wherein penetration of one or more fasteners is to be limited, although the material being fastened in place is not necessarily particularly compressible, such as in fragile or brittle materials.

Where applications call for the use of mechanical standoffs, prior art arrangements have typically relied upon separate components which are brought together in place to permit securing without crushing compressible materials, or while maintaining a desired distance between mechanical components, typically a screw or bolt and a nut. Thus, in a traditional assembly, a standoff is placed in the receiving aperture, a screw or bolt is passed

through the aperture and standoff, and a traditional washer and nut are secured on the opposite side. While such arrangements provide generally adequate resistance to crushing and maintain desired mechanical distances between the joined fasteners, they require several separate parts and can entail considerable assembly time for insertion of the standoff, and assembly of the fasteners. Moreover, the various separate parts must be individually manufactured, shipped, stored and brought together in the final assembly. In addition, the thickness of the materials may vary for a number of reasons, such as variation produced during manufacture.

There is a need, therefore, for an improved arrangement for securing fasteners to one another in applications requiring standoffs. There is a particular need for a technique that would facilitate assembly, while providing a high degree of resistance to crushing, and which would maintain desired distance between elements of the threaded assembly, even with variations in the dimensions of the materials and fasteners.

SUMMARY OF THE INVENTION

The present technique provides an assembly of an internally threaded fastener with a stemmed washer designed to respond to such needs. The washer may include a generally conical section that is designed to fit against an element being fastened in a manner of a conventional washer, and a standoff section extending from the conical section. The standoff and washer are hollow, thereby permitting a fastener, such as a screw or bolt, to be inserted therethrough. The washer can be dimensioned such that sufficient distribution of load is maintained to avoid damage to the elements being fastened. The standoff can be made any suitable length, and may be tailored to specific applications, depending upon the desired thickness or final dimensions of the elements being fastened.

The threaded fastener assembled with the stemmed washer may be any suitable type, such as a flanged nut. In the latter case, the nut presents a flange around a lower peripheral

edge that can be captured in a section of the washer. In one embodiment, an upstanding skirt on the washer is bent inwardly to capture a flange on a nut to maintain the nut in the assembly, while allowing the nut to rotate freely with respect to the washer. The entire assembly may be manufactured in a straightforward and cost-effective manner. In one exemplary method, for example, the washer and standoff element is made by a stamping process, with an open skirt extending upwardly from the washer portion. A flanged nut is then placed over the washer and the skirt is crimped or otherwise deformed to close the skirt slightly around the flange of the nut to complete the assembly and retain the nut in place, while allowing its free rotation.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings in which:

Figure 1 is a perspective view of a fastener and stemmed washer assembly in accordance with certain aspects of the present technique;

Figure 2 is a sectional view through the assembly of Figure 1 illustrating an exemplary configuration of the internally threaded fastener and stemmed washer;

Figure 2A is a detailed view of a portion of the stemmed washer, taken generally along line 2A-2A of Figure 3;

Figures 3 and 4 are sectional views of the assembly illustrated in Figures 1 and 2, illustrating installation with a mating fastener to maintain elements in a desired location within a final assembly; and

Figures 5 and 6 are sectional views of the assembly of Figures 1 and 2 showing steps in progressive manufacture of the assembly for retaining the threaded fastener within the stemmed washer.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

Turning now to the drawings and referring first to Figure 1, an assembly is illustrated in accordance with the present technique and designated generally by reference numeral 10. The assembly includes an internally threaded fastener 12 secured to a stemmed washer 14. In the illustrated embodiment the fastener 12 is a hex nut having hex flats 16 for interfacing with a conventional wrench. Internal threads 18 are provided for interfacing with a mating threaded fastener as described in greater detail below. A peripheral flange 20 is formed around a base of fastener 12 to interface with a corresponding portion of the stemmed washer to maintain the fastener in the assembly and to permit free spinning of the fastener for securement in an application.

The stemmed washer 14 includes features which serve both as a conventional washer, as a standoff, and as a retaining structure for the fastener 12. In the illustrated embodiment, the stemmed washer 14 thus includes a generally conical washer portion 22 integrally formed with a standoff portion 24. The generally conical washer portion 22 serves as a spring washer. Standoff portion 24 is generally right cylindrical in shape in the illustrated embodiment, although other overall shapes (e.g., tapered) may be employed. Moreover, the shape and contour of the washer portion 22 may be adapted for various purposes, and may deviate from the conical shape illustrated. The retaining portion 26 extends upwardly from the washer portion 22 and extends inwardly slightly over the flange 20 of the fastener to retain the fastener within the assembly. In a present embodiment, the retaining portion 26 fits loosely around the flange 20 to permit free spinning movement of the fastener within the assembly.

Referring to Figure 2, the assembly of Figure 1 is illustrated in cross-section. As noted above, the assembly 10 includes a fastener 12 and a stemmed washer 14. The stemmed washer includes a washer portion 22, a standoff portion 24, and a retaining portion 26. In the illustrated embodiment, the retaining portion 26 generally forms an upstanding skirt 28 bent inwardly towards the fastener 12 so as to retain the fastener by interference with the flange 20 provided at the lower extremity of the fastener. While the upstanding skirt 28 may have any suitable shape and contour, in the illustrated embodiment the skirt is angled inwardly slightly through an angle 30 to form a cavity 32 in which the fastener is retained. The fastener thus rests upon an inner surface 34 of the retaining portion 26 and exerts force against the inner surface 34 when drawn into engagement with a mating fastener. The washer portion 22 presents an outer surface 36 at its lower face opposite the inner surface 34 for contacting an element to be secured in place. The washer portion 22 is comprised of an elastically deformable material, such as a plastic or soft metal. The standoff portion 24 has an aperture 38 extending therethrough for receiving a mating fastener as described below. Aperture 38 is surrounded by side walls 40, which is noted above, may be straight cylindrical in shape as illustrated, or may be contoured, flared, or otherwise bent or ridged. Various lengths of the standoff portion 24 may be provided. An abutment end 42 of the standoff portion 24 serves to contact a mating surface, such as of a mating fastener as described below.

Referring generally to Figures 2 and 2A, the outer surface 36 of the washer portion 22 has an area of abutment 44 with a mating fastener. The distance from the area of abutment 44 to the abutment end 42 defines the effective height of the standoff portion 24. The effective height of the standoff portion 24 of the illustrated embodiment is variable due to the conical shape of the generally conical washer portion 22 and the ability of the washer portion 22 to be elastically deformed. The washer portion 22 extends from the standoff portion 24 so that there is an angle 45 between the area of abutment 44 and the standoff portion 24. The washer portion 22 is adapted so that the angle 45 is biased to an acute

angle. The distance 46 from the area of abutment 44 to the abutment end 42 when the washer portion 22 is un-deformed defines the minimum effective height of the standoff portion 24.

A force exerted by the fastener 12 against the inner surface 34 will tend to elastically deform and flatten the generally conical washer portion 22 against the mating fastener or materials captured therebetween. As the generally conical washer portion 22 flattens, the angle 45 between the area of abutment 44 and the standoff portion 24 increases. The distance 48 between the area of abutment 44 and the plane of the abutment end 42 when the washer portion 22 is approximately transverse to the top 49 of the standoff portion 24, as represented by the dashed line in Figure 2A, defines a maximum effective height of the standoff portion 24. The difference 50 between the maximum effective height and the minimum effective height thereby provides a range of variability in the effective height of the standoff portion 24. The difference 50 is a function of angle 45 and the length of the washer portion 22 from the top 49 to the area of abutment 44. The length of the washer portion 22 from the top 49 to the area of abutment 44 generally defines the hypotenuse of a right triangle formed by the standoff portion and the washer portion. The difference 50 is the adjacent side of the right triangle to angle 45. Multiplying the cosine of angle 45 by the length of the hypotenuse provides the length of the adjacent side, i.e., the difference 50 between the maximum effective height and the minimum effective height. Varying either angle 45 or the length of the washer portion 22 will vary the difference 50 between the maximum effective height and the minimum effective height.

The assembly of Figures 1 and 2 is illustrated in an application in Figures 3 and 4. As shown in Figures 3 and 4, the assembly 10 is designed to cooperate with a mating fastener 52, such as a screw or bolt, which is received within the internally threaded fastener 12 of the assembly. In practice, the assembly 10 may be simply inserted into apertures formed within elements to be secured to one another, such as element 54 and element 56 in

the illustrated embodiment of Figure 3, and the mating fastener 52 inserted from an opposite side. The mating fastener 52, and/or the fastener 12 may then be rotated to join the assembly 10 to the mating fastener 52, with the elements 54 and 56 lodged therebetween. In the illustrated embodiment the fastener 12 is free to rotate within assembly 10 as described above. In certain applications, however, the fastener may be fixed with respect to the retaining stemmed washer, such that only mating fastener 52 is rotated for securement.

As illustrated in Figure 4, the final assembly presents an actual length or dimension 58 between the area of abutment 44 of the outer surface 36 and the abutment end 42 of the mating fastener 52. It should be noted that the final dimension 58 may provide for loose attachment of the elements to one another, or slight crushing or compression of one or both elements. The washer portion 22 serves as a spring washer to buffer the force applied to the fastened elements. In addition, the ability of the washer portion 22 to be elastically deformed over a range of angular movement enables the fastener 10 to accept for tolerances in the manufacturing process of the fastened member, or members, as well as the standoff portion 24. The arrangement is thus particularly well suited to fastening components that may be damaged or deformed, or otherwise vary from an intended or uniform thickness, such as plastics, rubbers, expanded metals, and so forth. The arrangement is also particularly well suited to fastening components for which dimensions should be maintained or over-pressure should be avoided, such as metal, glass, and other harder and dimensionally stable components. Consequently, the outer surface 36 may or may not be transverse to the standoff portion 24. Therefore, the final dimension 58 may or may not be equal to the maximum effective length of the standoff portion 24. However, in the illustrated embodiment the outer surface 36 is transverse to the standoff portion and the final dimension 58 is equal to the effective length 48 of the standoff portion. Furthermore, when the generally conical washer portion 22 is flattened, much, if not all, of the abutment surface 36 may be the area of abutment 44.

Figures 5 and 6 illustrate progressive manufacturing assembly of the elements described above. In a present embodiment, a drawing or stamping operation is used to form a blank 60. The integral washer portion 22 is presented to a generally upstanding open skirt 62 of blank 60. With the fastener 12 thus in place, the open skirt 62 of Figure 5 is bent inwardly, such as in a crimping operation, as illustrated by arrows 64 in Figure 6, to define the cavity 32. As noted above, while this operation may secure the fastener rigidly within the assembly to prevent rotation, in a presently preferred configuration, the fastener 12 may freely spin within the cavity 32 to allow securement to the mating fastener 52, while the stemmed washer remains stationary.

While the invention may be susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and have been described in detail herein. However, it should be understood that the invention is not intended to be limited to the particular forms disclosed. Rather, the invention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the following appended claims.